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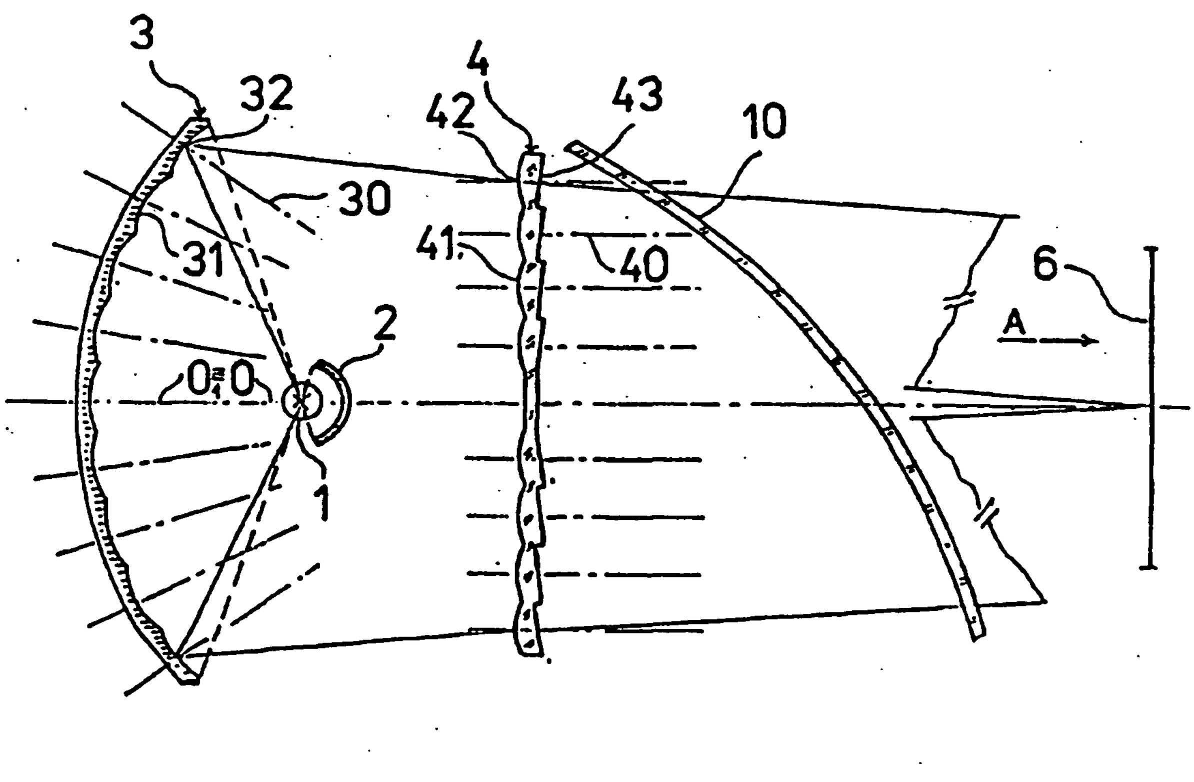
(54) Title: LIGHTING SYSTEM FOR SPOTLIGHTS, PROJECTORS AND ENLARGING APPARATUSES



(57) Abstract

The invention concerns a lighting system for spotlights, for automobile headlights, for medical and industrial spotlights. It consists of the light source (1), particularly the halogen light bulb, auxiliary mirror (2), the main mirror (3), consisting of a system f concave spherical mirrors (31), and a composite lens (4). All of these elements lie on the main optical axis (0). If a system of condensers (5) and an objective (7) is added to the basic part, the system can be used for cinema projectors and slide projectors.

Lighting system for spotlights, projectors and enlarging apparatuses

Background of the invention

1. Field of the Invention

The invention concerns a lighting system for spotlights, projectors and enlarging apparatuses, which provides an intensive and uniform illumination of a given area at a given distance. It consists of a source of light, an auxiliary mirror and the main mirror. Another part of the system is a composite lens, consisiting of a net of individual converging lenses, which direct the light rays coming from the source into the required plane, where they create the light spot.

2. The Prior Art

There exist many lighting systems used as automobile headlights. These systems are usually made by a continuous parabolic reflector covered by a glass cover with diverging elements. The light source is a halogen bulb with two filaments; one is for distant lighting and the other one for subdued lighting with an inner diaphragm that allows limitation of the subdued light beam. In order to decrease the reflector´s vertical size, the classical paraboloidal reflector was remodelled into the shape of a homofocal reflecting area in such a way that this reflecting area was divided into a system of discretely connected paraboloidal segments with the same optimized focal length. The need for another decrease of the headlight´s size lead to a production of an ellipticdioptric system. Its reflector has a shape of a rotational or polyelliptic ellipsoid with three axes. In one of its focuses there is the filament of the bulb and in the second one there is a diaphragm. The planoconvex lens, situated in the second focus of the ellipse, directs the output light rays so that they are parallel with the optical axis of the syst m. This l ns also

projects the diaphragm into the luminous background of the reflector. This process defines distribution of the subdued headlight´s illumination.

Since there is a bulb with one filament, this system can be used for subdued light only. Therefore one more lamp of a similar or the same construction is necesarry for a distant lighting apparatus. This apparatus has a very small height and it creates subdued lighting of good intensity and homogenity with a sharp boundary between light cone and darkness. Another apparatus unit with an increased reach of subdued lighting has a reflector of the type with a freely formed reflecting area, which is continuous and closed in such a way that, without the influence of a covering glass, the reflector projects to the required space elementary images of a single filament bulb. Even without the diaphragm, it makes a boundary between darkness and light. Light output capacity of such a system proportionally increases with the strength of the reflector and it allows also the using of its lower part, what increases the efficiency. Nevertheless, for a distant lighting an extra apparatus is needed. By the use of the conception with freely formed reflecting area an improved projective elliptical dioptric system of the lighting apparatus is achieved. The original ellipsoid is remodelled into a general area with a higher amount of light beam in the non-diaphragmed part of the focal plane. The reflector is more open in its upper part and more closed in its lower part. The light ouput of such a system is much higher in comparison with the previous system.

Similar lighting systems can be used for different lighting purposes, e.g. in the health service, as spotlights used in stomatology. These systems consist of a known type of planary lighting device using mostly as light sources a halogen bulb, and a cold reflecting concave mirror. Its reflecting part is arranged as composite mirror, which directs the light spot into the requir d plane.

The main disadvantage of pr sent automobile lighting systems c nsists in their low lighting effectiveness. Moving vehicles use the beam of light rays, reflected by differently shaped mirrors, and the luminous flux coming out of light source straight ahead is not used and is therefore often shaded. Dazzling effect is another big disadvantage of such a lighting device, since almost all systems used so far give out an intensive light coming from the filament of the bulb, which is visible from the space before the spotlight. Both sharp edge between light and darkness and the uniformity of light beam intensity are difficult to obtain, the consequence of which is rather complicated systems. The big size of these lighting devices and the pitch of their covering glasses make suitable aerodynamic designing of the front part of the automobile to be a rather difficult task.

Spotlights used in stomatology have similarly low light effectiveness. The light, coming from the light source, is directed to the front space and, therefore, stays unused. When the light is turned on, the light beam reaches also the patient´s eyes and causes unpleasant dazzle. The dentist´s mirror can also reflect unwanted light from different mirroring areas; thus the observed image can be disturbed. During some elemental operations, e. g. during preparation of the crown, the light, reflected from the metal, creates a certain kind of barrier between the preparation opening and the reflecting surface of the crown. This makes operation more difficult. The reflectors with a composite mirrors are relatively big; when the spotlight is adjusted into an inapropriate position, the dentist can easily interrupt the light beam with his head and decrease the amount of light coming out from the spotlights and shining onto the desired spot on patient´s body.

If another optimal system, for example a system of condensors, is added to one of the systems mentioned and described above, the resulting system could be us d for lighting of the first principal plan , in which a fi ld of negative or positive filmstrip is inserted. Such field is

then projected, with the h lp of an objective, into the image plane. This lighting system is suitable mainly for projectors, slide projectors and nlarging apparatus s.

There are slide projectors of big formats with intensive light sources. Their structure and different luminance of the light source influence negatively the lighting uniformity of the plane of incidence. Therefore, such lighting systems contain optical parts with composite members, and instead of a simple convex mirror, a composite mirror is used. Moreover, between two deflecting mirrors an intermediate image-forming system, consisting of two plates with composite lenses can placed. For big format slides, a honeycombed condenser system, consisting of a composite lens, is normally used. There are also used lighting systems made with one of the honeycombs as a composite mirror. The mirror consists of groups of curved reflacting plates, placed in one plane. The disadvantage of these systems is their big size and high number of complicated optical elements, what is the cause of bigger loss of the luminous flux as well.

In slide projectors of smaller formats are for illuminating systems used both spherical mirror with a light source and lens condenser system with an aspherical element and a thermal filter. The disadvantage of such optical systems consists in the fact that the rectangular frame with film strip placed in the first principal plane, is lit by a beam of light of a circular shape, which causes a loss of luminous flux. The angle of the luminous flux is furthermore limited by the outer rays, caught by a spherical or aspherical condensor, and therefore this angle cannot be further increased.

In enlarging apparatuses, dedicated mainly to amateurs, mainly the light sources for large areas are used, particularly opal lamps with a lens condenser system, or lamps with elliptic reflecting ar a. In some enlarging apparatus s can b us d an independent head f r a colour photograph with its wn light source, usually a halogen bulb

with a diverging syst m, a mixing chamber for continuously adjustabl col ur filtration with an adjustable density diaphragm. Yet, such systems have very little effectivity.

Objects of the invention

The present lighting systems are limited by the disadvantages just outlined. The subject matter of our invention consists in that the main mirror, whose optical axis is identical with the main optical axis, on which the light source with the auxiliary mirror is positioned, has its concave reflecting surface formed as a composite mirror. This composite mirror consists of a system of concave spherical mirrors, whose side walls touch one another and whose vertexes are arranged on the surface, which has a shape of a rotational conic section, having in the meridian plane a shape of a non-circle curve. The particular reflecting areas of the concave reflecting mirrors have such a focal length and such an angle of inclination of the optical axis that they create the optical image of a light source in the vertexes of the geometrically corresponding lenses of the composite lens, which consists of a network of individual lenses and which is also arranged on the main optical axis. Relevant elementar areas of the concave spherical mirrors are projected into the required plane of the light spot.

When looking in the direction of the main optical axis and in an imaginary plane perpendicular to the main axis, each concave spherical mirror shape corresponds to the contour of plane of the projected light spot. The concave spherical mirror are further arranged in zones. Radii of curvature of these mirrors in one zone are equal, but differ from those of another zone.

Individual lenses of the composite lens have the same shape and size and they maximally correspond to the shape and size of the field of vision of the light source. They are also arranged in zones, which can be shifted in a direction of the main axis. The radii of curvature of

lenses f one zone differ from th radii of curvature of lenses of an ther z ne. Vertexes of all lenses are arranged in one plane, perpendicular to the main optical axis and their optical axes are parallel to the main one. Under these circumstances the lenses are planoconvex. The back surface of particular lenses of the composite lens can be for certain types of lighting systems inclined to their optical axes in order to create an optical wedge. It is also possible to make the whole back surface of the composite lens concave. Alternatives of arrangement of composite lens described above lead to the directing of the light beam into a required plane.

In case of using the lighting system for projecting purposes, particularly in slide projectors and enlarging apparatuses, a system of condensers can be added to the lighting system, which directs the luminous flux to a plane, in which a slide is placed.

The main advantage of the invented lighting system consists in its illumination effectiveness at a uniform distribution of the light beam with minimal dazzling effect. The size of the system is very small both when using this new system as a source of straight light, e.g. for automobile headlights or medicine spotlights, and with an added condenser system.

Brief description of the drawings

Fig. 1 is a schematic picture of lighting system of an automobile headlight;

Fig. 2 is a light spot of a lighting system of a distant headlight of an automobile for an illumination of a distant part of the highway;

Fig. 3 is a light spot of a lighting system of the subdued headlight of an automobile for a subdued illumination of th highway view d in the dir ction A;

Fig. 4 is a schematic picture of an optical system of

spotlight used in health service;

Fig. 5 is a schematic picture of a lighting system for a big format slid pr j ctor;

Fig. 6 is a schematic picture of a lighting system for a small format slide projector; and

Fig. 7 is a schematic picture of a lighting system for an enlarging apparatus.

Detailed description of the preferred embodiment

Figure 1 schematically shows a lighting system for moving vehicles, especially an automobile headlight optical system. It consists of the light source 1, what is a single filament halogen bulb, placed on the main optical axis 0, on which is arranged an auxiliary mirror 2 as well. Another part of the system is the main mirror 3, whose optical axis 0_1 is identical with the main optical axis 0. It is made as a composite mirror, formed by a network of concave spherical mirrors 31 of a rectangular shape, whose side walls tightly abut on each other and whose vertexes 32 are arranged in an imaginary plane, making an aspherical curve in the meridian plane, rotary symetrical around the optical axis 0_1, identical with the main optical axis 0. Another part is a composite lens 4, placed at the main optical axis 0 as well. It consists of a system of converging lenses 41, which have hexagonal shapes. Again, their side walls abut tightly on each other. Their vertexes 42 are arranged in a common plane, perpendicular to the main optical axis 0, and their back walls 43 are bevelled, so that they make optical wedges. All optical axes 40 are parallel to the main optical axis 0.

Between the mirror 3 and the composite lens 4 a condition must be fulfilled that the foci of the lenses 41 and the foci of the concave spherical mirrors 31 make dot networks of the similar shape and that a ray, coming from the middle of the light source 1 after reflection from the vert x 32 of the concave spherical mirror 31 is dir cted towards the vertex 42 of th geometrically corresponding

lens 41. The lighting system is c mpleted by a covering dioptrically neutral glass 10.

A beam of light rays, coming from th light source 1, including the part reflected from the reflecting surface of the auxiliary mirror 2, impinges onto the reflecting surface of the main mirror 3. Each of its concave spherical mirrors 31 creates an image of the light source 1 in the correspodning lens 41 of the composite lens 4, which projects the rectangular concave spherical mirror 31 at a given magnification to the plane of the light spot 6. Through this plane passes the beam of light rays in the shape of concave spherical mirrors 31 in the main mirror 3. The same amount of images as is the number of concave spherical mirrors 31 or the lenses 41 is concentrated here. This is valid both for distant headlights and for subdued headlights.

In Figure 2 can be seen the spot of a distant headlight of a car on a highway profile 61. This state is enabled by a proper arrangements of the back areas 43 of particular lenses 41 of the composite lens 4.

Figure 3 shows the light spot of the subdued headlights. Out of the picture follows that there is a higher concentration of the light spots in the central part of the plane than in the outer parts. This is also reached by a proper arrangement of the back areas 43 of the composite lens 4.

The main advantage of this headlight lighting system is its ability to reach a higher light effectiveness by using light rays reflected both from the main and auxiliary mirror and by a proper directing of the luminous flux to the required area. The luminous flux is directed only in the direction of the light spot without any disturbing and unnecessary lateral exposures. In a subdued headlight a very well confined border between light and dark areas and an optimally chosen light spot has been achieved. Such a h adlight is also suitabl f r track vehicles, wheel v hicles and military vehicles, where th re is a mechanical

diaphragm with particular openings placed behid the covering dioptrically neutral glass, to properly direct and dim the luminous flux according to requirements of the user.

In lighting sets for distant light, the light spot is concentrated into one figure. It is totally uniform and independent of the shape and division of light from the source. The dazzling effect on the on-coming cars or on oneself is decreased to a minimum level, as only the particular lit areas of the concave mirrors are projected into the plane of the light spot, while the intensive brightness of the light bulb filament doesn´t create an image in the space in front of the headlight. The outer front dimension of the subdued headlight with a single-filament halogen light bulb is comparable with the projecting systems of the headlight Super-ED. When the lighting area of the light source is diminished, for example when using a gas discharge lamp, it is possible to decrease the front size of the headlight. The covering glass without diverging elements is optically neutral and allows to increase the vertical and horizontal angle of tilting. This faciliates the solution of the aerodynamical design of the whole headlight and, therefore, also of the front radiator cover of a car.

This idea of a lighting system with only slight changes is also suitable for medical use, especially for stomatology, as could be seen in figure 4. After proper adjustment of the concave mirrors <u>31</u> of the main mirror <u>3</u> and the lenses <u>41</u> of the composite lens <u>4</u> it is possible to have the whole back area of this composite lens <u>4</u> in the shape of plane. The plane of the light spot is then uniformly lit. In the distance of 900 mm its dimensions reach up to 125 x 140 mm, what is the optimal size for stamotology. In this case, the sharp boundary between the light and dark area is reached, and dazzling of the pacient is minimal.

The lighting system can also be used in many other areas wh re minimal dazzling and uniform lighting of the

lumin us flux are needed, e.g. in television studios, in photographie studios, or work shops as theatre and film spotlights etc., where minimum dazzling and uniform illumination of the light spot in a given distance is being required.

If a condenser set is added to the above described lighting system, it may also be used for slide projectors or for projecting large size images, as shown in figure 5.

Such lighting system uses a high-pressure discharge lamp as the light source 1, an auxiliary mirror 2 and an intermediate projecting set, containing the main mirror 3, which is formed by a system of concave spherical mirrors 31, and the composite lens 4, consisting of a system of lenses 41. All these members are arranged on the main optical axis 0. The whole system and also the relations among the particular members are similar to that of the lighting system used for headlights of automobiles or for medicals lamps. Only the back surface of the composite lens 4 is made as diverging. This system is linked up to the condenser system 5, arranged on the main optical axis 0. It is composed of two convex lenses, the back one of which is exchangeable according to the focal length of the used objective 7.

Rays coming from the middle of the light source 1 and later reflected from the centres of the concave spherical mirrors 31 of the main mirror 3 come through the geometrically corresponding convex lenses 41 of the composite lens 4 with a diverging lens and through a condensor system 5, inersect approximately the middle of the plane of the light spot 6, where a slide is placed, which should be projected with help of the objective 7 to an image forming plane (not shown). In this system it is necessary that the ratio of the diameter of the outcoming light beam, coming from the composite lens 4, to the distance of the condenser system 5 from the composite lens 4, is equal to or smaller than the value of the relative opening of the objective 7. In the plane of the light spot

6 are again concentrated as many images of the concave mirrors 31, pr jected by the lenses 41 f the comp site lens 4, as is the number of the concave mirrors 31 or the number of lenses 41. This results in using practically the whole luminous flux and at the same time in a uniform distribution of the light and in a short total length of the whole system.

As follows from figure 6, it is possible to use this system, after certain modifications, for small format slide projectors. The idea and the description are similar to the above described case. There are nevertheless certain differences in the construction of the main mirror 3, of the lens 4 and of the condenser system 5. A halogen light bulb is used as the light source 1. The main mirror 3 consists of rectangular concave spherical mirrors 31 of the same size, which are arranged in lines, the neighbouring lines being displaced half of the width of one mirror 31. The geometrical centres of the mirrors 31 make a network similar to the geometrical network of lenses 41 of the composite lens 4. These concave spherical mirrors 31 whose vertexes 32 are arranged on an aspherical surface and whose optical centres are identical with the geometrical centres, lie at different radii from the main optical axis O. At the same time these concave spherical mirrors 31 with the same foci form zones, spherical mirrors 31 from differnt zones having different foci, in order to project the light source 1 to the vertexes 42 of the lenses 41, which are also arranged in zones, extended in the direction of the main optical axis O. The condenser system 5 consists of more elements; the first element is a diverging one and is constructianally adapted in such a way that the main rays intersect approximately the centre of the plane of the light spot 6 and that the whole light beam passes the objective 7. The back lens is exchangeable. The light source 1 is then projected approximately in the middle of the objective 7 in a geom trical network, analogous to that f the main mirror 3, and of the composite lens 4 in a surface, where the ratio

of the diameter of this ray bundle and the distance of the plane f the light spot 6 from this bundle is approximately equal to or smaller than the value of the relative opening of the objective 7.

By the above described solution, higher luminous flux together with a uniformly lit plane of the light spot 6 with the inserted slide is obtained, regardless of the shape and distribution of the light on the lighting area of the light source 1.

This system is almost identical with a lighting system for enlarging apparatuses with the possibility of projecting, as is shown in figure 7. For slide projecting, the system turns through 90° to the horizontal plane. The light source 1 is a halogen bulb. The system is completed with mirror 8, which directs the light beams onto the vertical plane. The back element of the lens condenser 5 is exchangeable according to the type of the projecting objective 7. A piece of black and white or colour filmstrip or a slide is placed in the plane of the light spot 6. Filters 9 for a colour photograph are placed near the composite lens 4; when inserted, they change colour filtration. By a grey filter (not shown) and by a mechanical diaphragm (not shown), the light density of white and colour light is regulated. The main mirror 3 has a reflecting layer, which allows heat radiation to pass through.

In this case too, a great intensity of light with the input power 50 W is reached together with the uniform distribution of light, what is, expecially for colour photograph, very important. Further advantage consists in that the system forms one structural unit both for magnifying black and white and colour photographs with a high luminous flux and for excellent slide projection.

The above described system provides some more possibilities of using of this newly designed lighting system, .g., in th sphere of professional pr j cting and reprographical techniques.

PATENT CLAIMS

1. The lighting system for spotlights, projectors and enlarging apparatuses for providing an intensive and uniform lighting of an area of a given size and at a given distance, consisting of a source of light, an auxiliary mirror, main mirror and composite mirror with converging optical elements directing the light rays, coming from the light source, into the required plane, where it creates the light spot, characterized in that the reflexing area of said main mirror (3) is created as a network of concave spherical mirrors (31), whose vertexes (32) are arranged on the surface, which has a shape of a rotational conic section, the axis of its rotation being its optical axis (O_1), having in the meridian plane a shape of a non-circle curve, optical axis (O_1) of said main mirror (3) being identical with the main optical axis (0), on which both the centre of said light source (1) and the auxiliary mirror (2) are arranged, the particular reflecting areas of the concave spherical mirrors (31) having a focal length and an inclination of their optical axes (30) to project an image of the light source to the vertexes (42) of geometrically corresponding lenses (41) of the composite lens (4), these particular lenses (41) projecting images of corresponding elemental areas of concave spherical mirror (31) of the main mirror (3) into the required plane of the light spot (6).

2. The lighting system according to claim 1, characterized in that every concave spherical mirror (31) of the main mirror (3), when looking in the direction of the main optical exis (0) and in an imaginary plane perpendicular to it, corresponds to the shape of the plane of the light spot (6), these concave spherical mirrors (31) abut tightly to each other by their side walls, the shape

and size of particular lens s (41) of the c mposite lens (4) corresponding as much as possible to the shape and size of the light source (1) field, and images of the light source (1), created by the concave spherical mirrors (31), pass through these lenses (41), whose sizes are the same and which abut tightly to each other by their sidewalls.

3. The lighting system according to claims 1 and 2, characterized in that the concave spherical mirrors (31) are arranged in zones, where a group of concave spherical mirrors (31) of one zone has the same radius of curvature, which differs from that of a group of concave spherical mirrors (31) of another zone.

4. The lighting system according to claims 1 and 2, characterized in that the lenses (41) are arranged in zones, where a group of lenses (41) of one zone is extended along the main optical axis (0) in comparison with group of lenses (41) of a different zone, and the radii of curvature of lenses (41) in one zone differ from the same in other zones.

5. The lighting system according to claims 1 to 4, characterized in that the vertexes (42) of the lenses (41) of the composite lens (4) are arranged in one plane, which is perpendicular to the main optical axis (0), and their optical axes (40) are parallel with this main optical axis (0), the lenses (41) being planoconvex.

6. The lighting system according to claims 1 to 4, characterized in that the back surfaces (43) of lenses (41) of the composite lens (4) are inclined against their optical axes (40).

7. The lighting system according to Claims 1 to 4, characterized in that the back surface of the composite l ns (4) is concave.

8. The lighting system according to claims 1 to 7, characterized in that in front of the light spot (6) plane a condenser system (5) is being arranged.

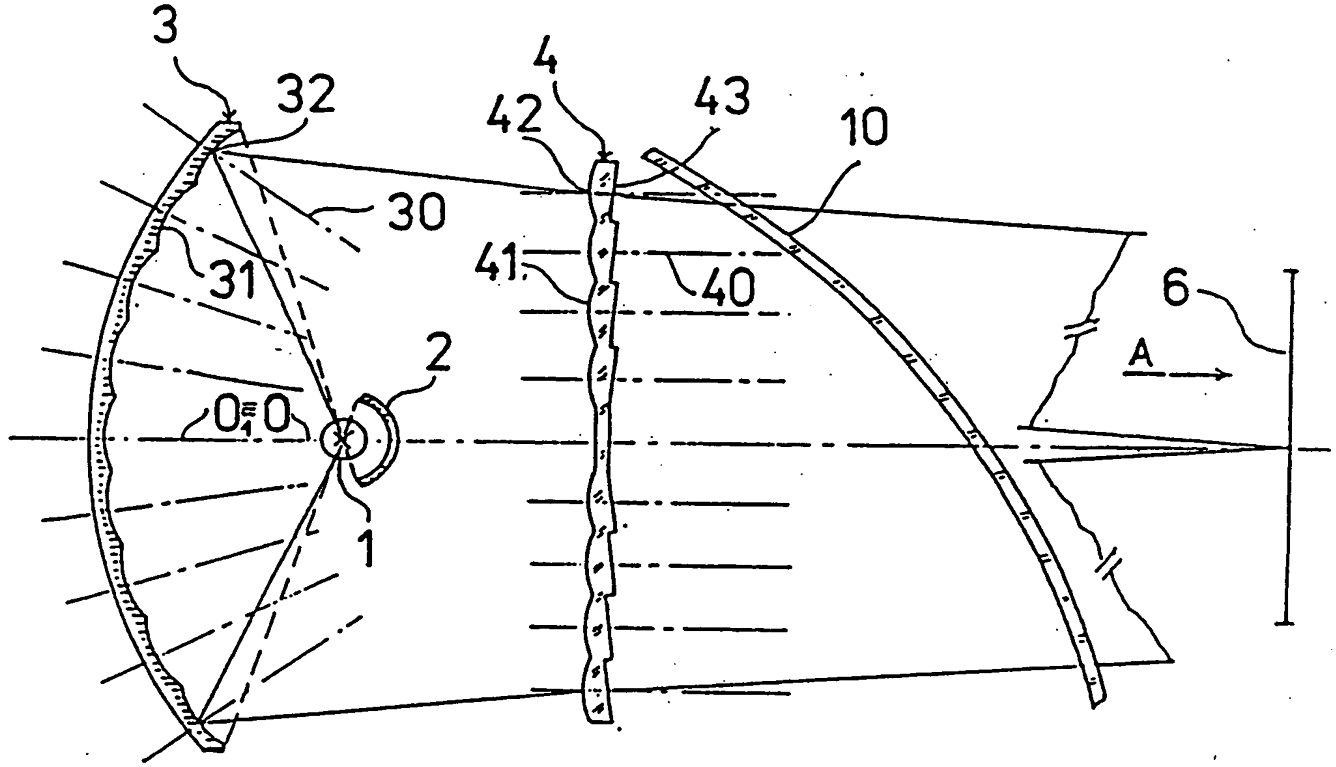


Fig. 1

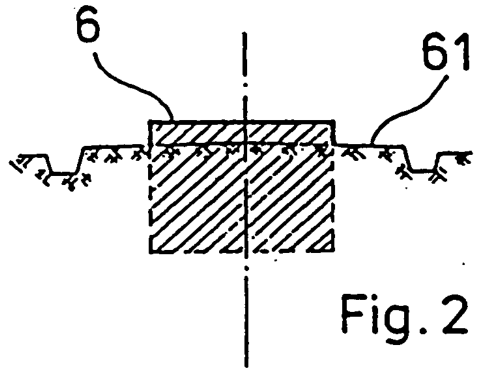


Fig. 2

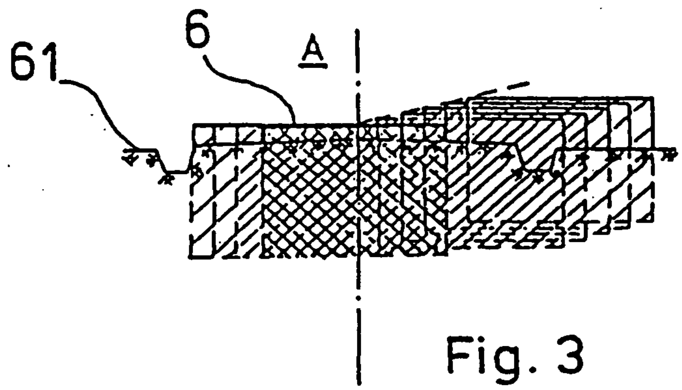


Fig. 3

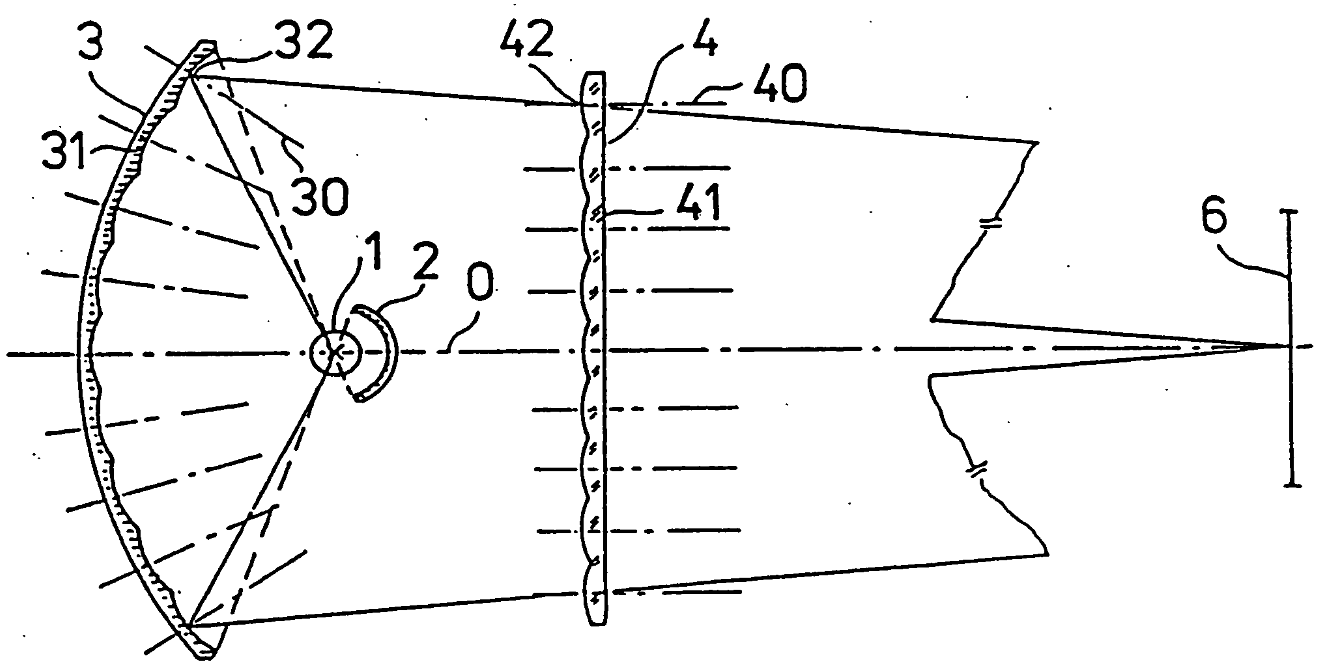


Fig. 4

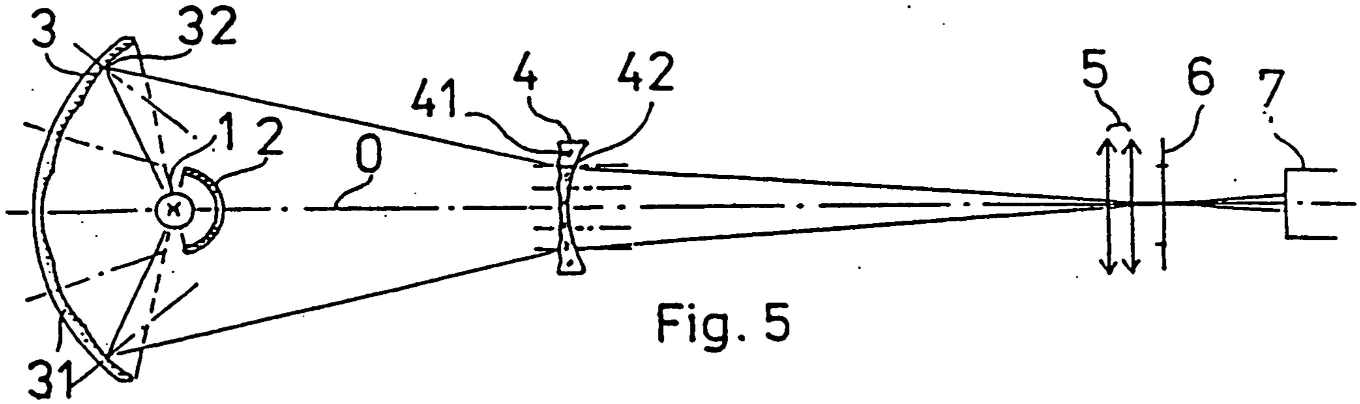


Fig. 5

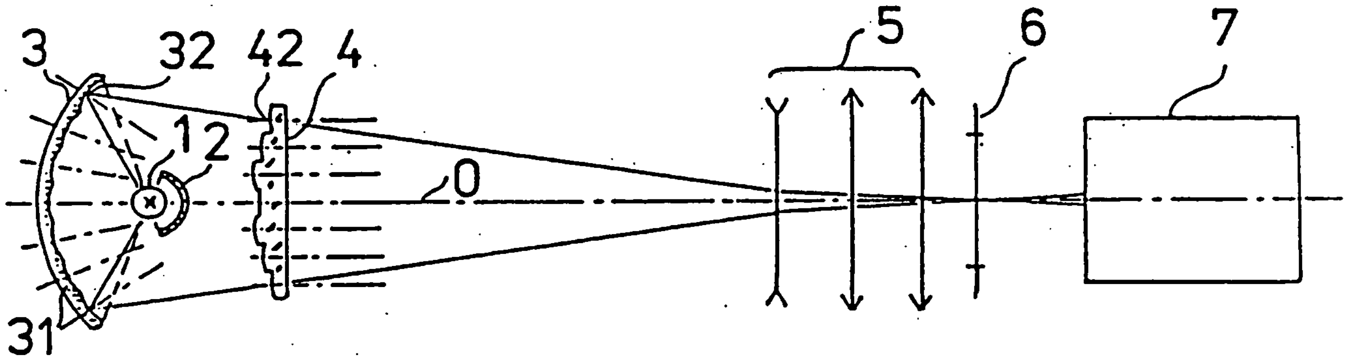


Fig. 6

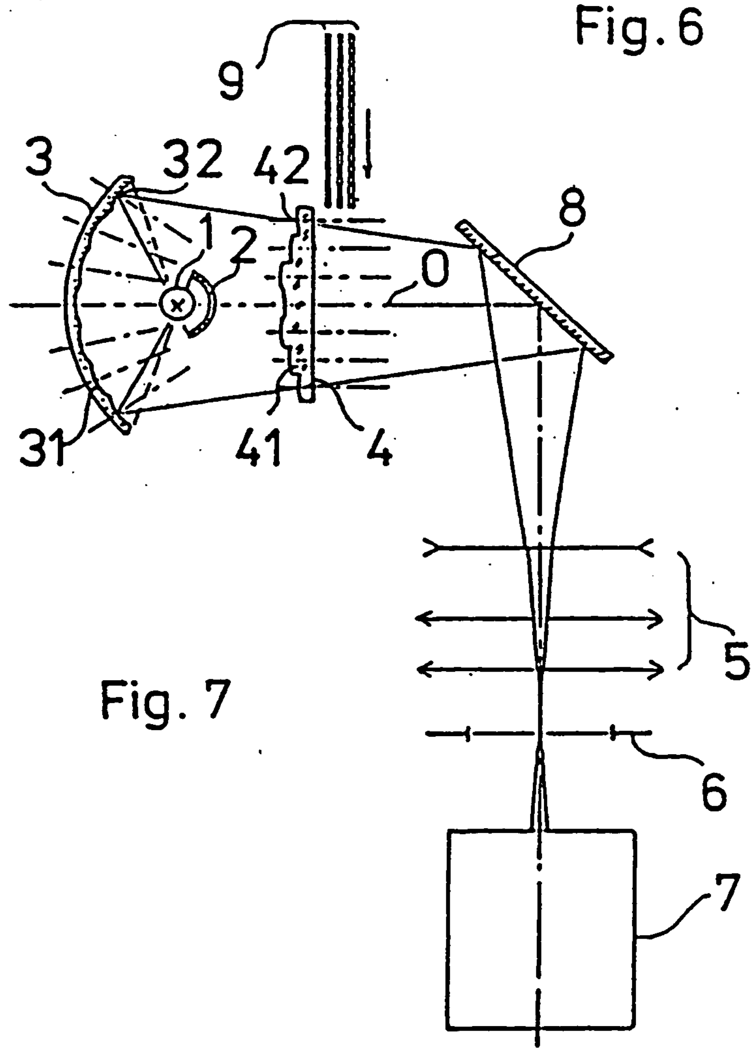


Fig. 7

INTERNATIONAL SEARCH REPORT

International Application No
PCT/CZ 93/00031

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 F21V13/04 F21V7/09 F21M1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 F21V F21M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE,B,10 34 116 (HENSOLDT & SÖHNE, OPTISCHE WERKE AG) 17 July 1958 see column 3, line 15 - line 68 see figures 1-5	1,4-7
A	US,A,4 035 631 (DAY, JR.) 12 July 1977 see the whole document	1,3
A	GB,A,1 084 778 (MEDICOR MUVEK) 27 September 1967 see page 1, line 82 - page 2, line 36 see page 2, line 103 - line 123 see claim 1; figure 3	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
13 April 1994	19. 04. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Mas, A

International application No.
PCT/CZ93/00031

INTERNATIONAL SEARCH REPORT

Box I Observations wher certain claims were found unsearchable (Continuati n of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 2
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
Claim 2 is incomprehensible to us. Futhermore, we wish to point out that:
a) line 5 of the claim 1 should read "___ and composite LENS with converging ___" instead of "___ and composite MIRROR with ___"
b) the wording used in the application is unusual for the technical field concerned.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searches without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Information on patent family members

International Application No
PCT/CZ 93/00031

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-B-1034116		NONE	
US-A-4035631	12-07-77	NONE	
GB-A-1084778		NONE	